

CLAIMS

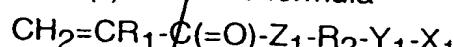
1. Polymers comprising a polymer backbone having pendant groups, obtainable by polymerizing monomers having such groups, characterized in that said polymers are obtained by copolymerizing monomers of at least three different classes selected from:

- (a) monomers having sulphate groups
- (b) monomers having sulphonate groups
- (c) monomers having sulphamate groups, and
- (d) monomers having polyoxyalkylene ether groups

2. Polymers comprising a polymer backbone having pendant groups, obtainable by polymerizing monomers having such groups, characterized in that said polymers are obtained by copolymerizing monomers of at least three different classes selected from:

- (a) monomers having sulphate groups
- (b) monomers having sulphonate groups
- (c) monomers having sulphamate groups, and
- (d) monomers having polyoxyalkylene ether groups
- (e) monomers having zwitterionic groups

3. Polymers according to Claim 1 or 2 characterized in that said monomers in Classes (a), (b) and/or (c) have the formula



where

R_1 is H or CH_3 ;

R_2 is a linear or branched alkylene of 2-10 carbon atoms, phenylene, phenyl alkylene with 1-10 carbon atoms in the alkylene structure or the polyoxyalkylene structure $[\text{CH}_2-\text{CHR}_1-\text{O}]_n$ where R_1 is H or CH_3 and n is from 2 to 50;

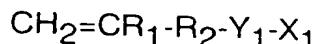
Z_1 is oxygen (-O-) to give an ester linkage or secondary amine (-NH-) to give an amide linkage;

Y_1 is (-O-) or (-NH-) or is absent; and

X_1 is sulphonate ($-\text{SO}_3^-$).

together with an acceptable balancing cation.

4. Polymers according to Claim 1 or 2 characterized in that said monomers in Classes (a), (b) and/or (c) have the formula:



where

R_1 is H or CH_3 ;

R_2 is a linear or branched alkylene of 1-10 carbon atoms, phenylene, phenyl alkylene with 1-10 carbon atoms in the alkylene structure or the polyoxyalkylene structure $[\text{CH}_2-\text{CHR}_1-\text{O}]_n$ where R_1 is H or CH_3 and n is from 2 to 50;

Y_1 is (-O-) or (-NH-) or is absent; and

X_1 is sulphonate ($-\text{SO}_3^-$).

together with an acceptable balancing cation.

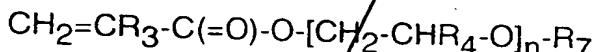
5. Polymers according to any one of Claims 1 to 4 characterized in that the monomer containing sulphate groups is selected from salts of 2-sulphatoethyl methacrylate, 2-sulphatoethyl acrylate, 3-sulphatopropyl methacrylate, 3-sulphatopropyl acrylate, 4-sulphatobutyl methacrylate, 4-sulphatobutyl acrylate, allyl sulphate, methyl allyl sulphate, 3-buten-1-sulphate, 3-buten-2-sulphate, 2-methyl-2-propane-1-sulphate, 2-methyl-3-buten-1-sulphate, 3-methyl-3-buten-1-sulphate, 2-sulphatoethyl methacrylamide, 2-sulphatoethyl acrylamide, 3-sulphatopropyl methacrylamide, 3-sulphatopropyl acrylamide, 4-sulphatobutyl methacrylamide, 4-sulphatobutyl acrylamide, sulphato polyoxyalkylene methacrylate, and sulphato polyoxyalkylene acrylate.

6. Polymers according to any one of Claims 1 to 5 characterized in that the monomer containing sulphonate groups is selected from salts of 2-sulphoethyl methacrylate, 2-sulphoethyl acrylate, 3-sulphopropyl methacrylate, 3-sulphopropyl acrylate, vinyl sulphonate, allyl sulphonate, methyl allyl sulphonate, p-styrene sulphonate, 2-acrylamide-methylpropanesulphonate, 3-sulphopropyl ethoxy methacrylate, 3-sulphopropyl ethoxy acrylate, 3-sulphopropyl polyoxyalkylene methacrylate, and 3-sulphopropyl polyoxyalkylene acrylate.

7. Polymers according to any one of Claims 1 to 6 characterized in that the monomer containing sulphamate groups is selected from salts of 2-

sulphamatoethyl methacrylate, 2-sulphamatoethyl acrylate, 3-sulphamatopropyl methacrylate, 3-sulphamatopropyl acrylate, 4-sulphamatobutyl methacrylate, 4-sulphamatobutyl acrylate, allyl sulphamate, methyl allyl sulphamate, 2-sulphamatoethyl methacrylamide, 2-sulphamatoethyl acrylamide, 3-sulphamatopropyl methacrylamide, 3-sulphamatopropyl acrylamide, 4-sulphamatobutyl methacrylamide, 4-sulphamatobutyl acrylamide, sulphamato polyoxyalkylene methacrylate and sulphamato polyoxyalkylene acrylate.

8. Polymers according to any one of Claims 1 to 6 characterized in that said monomers in Class (d) have the formula



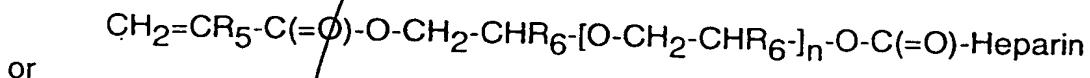
where R_3 and R_4 , which may be the same or different, are each H or CH_3 ; R_7 is H or alkyl with from 1 to 5 carbon atoms; and n is from 2 to 50.

9. Polymers according to any one of Claims 1 to 8 characterized in that said polymers comprise heparin monomer units having heparin, linked to a polymerizable moiety having a carbon-carbon double bond.

10. Polymers according to any one of Claims 1 to 8 characterized in that said polymers comprise monomer units having hirudin, warfarin or hyaluronic acid linked to a polymerizable moiety having a carbon-carbon double bond.

11. Polymers according to Claim 9 characterized in that the heparin monomer units comprise vinyl, allyl, methallyl, acrylate or methacrylate groups.

12. Polymers according to Claim 9 or 11 characterized in that the heparin monomer has the formula:



$$\text{CH}_2=\text{CR}_5-\text{C}(=\text{O})-\text{O}-\text{CH}_2-\text{CHR}_6-[\text{O}-\text{CH}_2-\text{CHR}_6-\text{O}]_n-\text{O}-\text{C}(=\text{O})-\text{O}-\text{Heparin}$$

where R_5 and R_6 , which may be the same or different, are each H or CH_3 ; and n is from 0 to 49.

13. Polymers according to any one of Claims 1 to 12 characterized in that said polymers contain additional monomer units derived from acrolein.

14. A medical device having a coating of a polymer according to any one of Claims 1 to 13.

15. A method of forming a coating of a polymer according to any one of Claims 1 to 14 on a medical device, characterized by forming an ungelled partial polymer by reacting a solution of an amine polymer with a crosslinking agent, activating the medical device by solution coating with said partial polymer, and depositing the polymer on the resulting activated medical device.

16. A method according to Claim 15 characterized in that the amine polymer is polyethylene imine.

17. A method according to any one of claims 15 and 16 characterized in that the crosslinking agent is an aliphatic monoisocyanate or diisocyanate.

18. A heparin monomer having the formula:
$$\text{CH}_2=\text{CR}_5-\text{C}(=\text{O})-\text{O}-\text{CH}_2-\text{CHR}_6-\text{[O-CH}_2-\text{CHR}_6-\text{]}_n-\text{O}-\text{C}(=\text{O})-\text{Heparin}$$
or
$$\text{CH}_2=\text{CR}_5-\text{C}(=\text{O})-\text{O}-\text{CH}_2-\text{CHR}_6-\text{[O-CH}_2-\text{CHR}_6-\text{]}_n-\text{O}-\text{C}(=\text{O})-\text{O}-\text{Heparin}$$
where R_5 , R_6 and n have the meanings given in Claim 12.

19. A method of forming a heparin monomer according to Claim 16, characterized in that a hydroxyl terminated compound of the formula:
$$\text{CH}_2=\text{CR}_5-\text{C}(=\text{O})-\text{O}-\text{CH}_2-\text{CHR}_6-\text{[O-CH}_2-\text{CHR}_6-\text{]}_n-\text{OH}$$
is reacted with carbonyldiimidazole to form an activated imidazoyl carbonate of the formula:
$$\text{CH}_2=\text{CR}_1-\text{C}(=\text{O})-\text{O}-\text{CH}_2-\text{CHR}_2-\text{[O-CH}_2-\text{CHR}_2-\text{]}_n-\text{O}-\text{C}(=\text{O})-\text{Im}$$
wherein R_5 , R_6 and n have the meanings given in Claim 18 and the activated imidazoyl carbonate is coupled with heparin at a basic pH.

20. A coating material comprising a polymer according to any one of claims 1 to 13.

21. A coating material according to Claim 20 characterized in that it is adapted for use on a surface of a medical device.